Following Olivine-Spinel Phase Transition in Fayalite with TIPS	X17B1

J. Chen and D.J. Weidner (CHiPR, SUNY, Stony Brook)

The mechanism of the olivine-spinel phase transition has been investigated by several groups. Sung and Burns [1,2] proposed a diffusion-controlled process, incoherent nucleation of the spinel phase and subsequent crystal growth; Kronberg [3] and Poirier [4] proposed a shear mechanism, stacking faults in oxygen lattice of olivine in company with cation reordering. More interesting result reported by Furnish and Bassett [5] from their in situ x-ray diffractions in a diamond anvil cell (DAC) suggested a two-step shear mechanism with stacking faults prior to the cation reordering. Using the newly developed translating imaging plate system(TIPS) for high pressure diffraction at X17B1, we studied the mechanism of the olivine-spinel phase transition in fayalite.

The experiment was carried out by compressing the sample at room temperature into the spinel stability field (6.9 GPa) and then heating the sample. The sample transformed from olivine to spinel during the heating. A time-resolved pattern was recorded when the temperature increased from 300°C to 400°C. The transporting speed of the imaging plate was 3.25mm/min. The heating rate was 1.75 $^\circ$C/min. Figure 2 shows the time resolved diffraction pattern. Structure refinements were done base on the diffraction patterns during the phase transition. Figure 2 shows an example of the refinement. The result shows that the oxygen framework of spinel structure is formed prior to the ordering of cations into the tetrahedral and octahedral sites.

[1] J. P. Poirier, J. Geophys. Res. 87, 6791(1982).
[2] C. M. Sung and R. G. Burns, Earth Planet. Sci. Lett. 32, 165(1976).
[3] M. L. Kronberg, Acta Metall. 5, 507(1957).
[4] J. P. Poirier, in Anelasticity in the Earth, Geodyn. Ser. vol. 4, edited by F. D. Stacey et al. p. 113-117, AGU, Washington D.C. (1981).
[5] M. D. Furnish and W. A. Bassett, J. Geophys. Res. 88, 10333(1983).

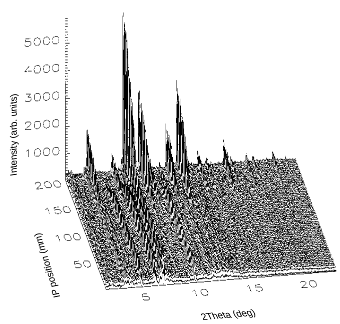

Figure 1. 3-D plot of time resolved diffraction patterns for the olivine-spinel phase transition in fayalite.

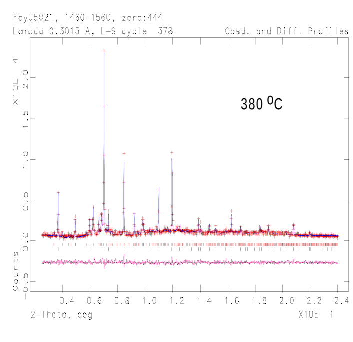

Figure 2. Reitveld refinement of the diffraction pattern at midway of the olivine-spinel phase transition.